

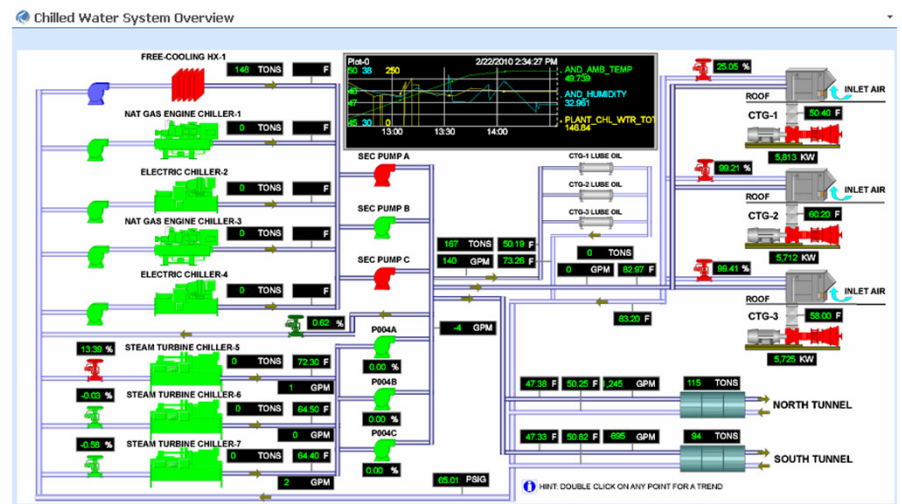
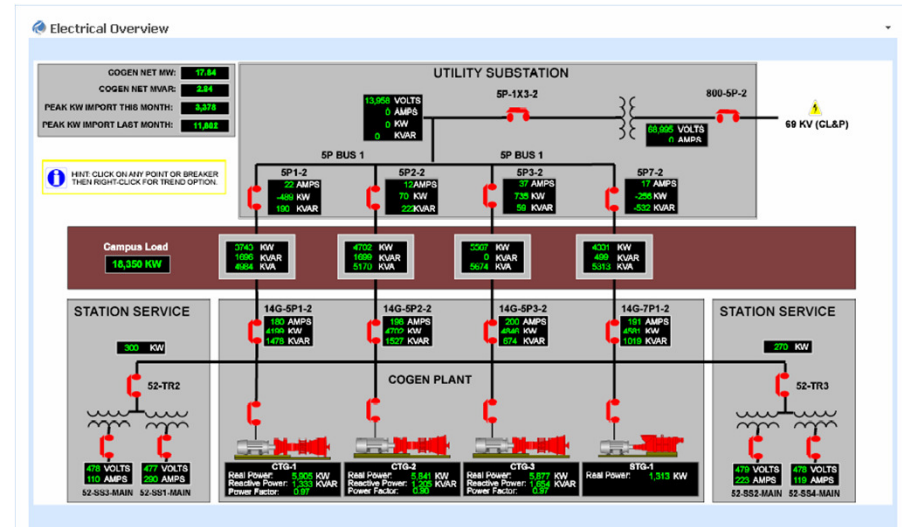
# Scalable Microgrids for Enhancing Energy System Resiliency and Efficiency

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University of Connecticut  
April. 21, 2014



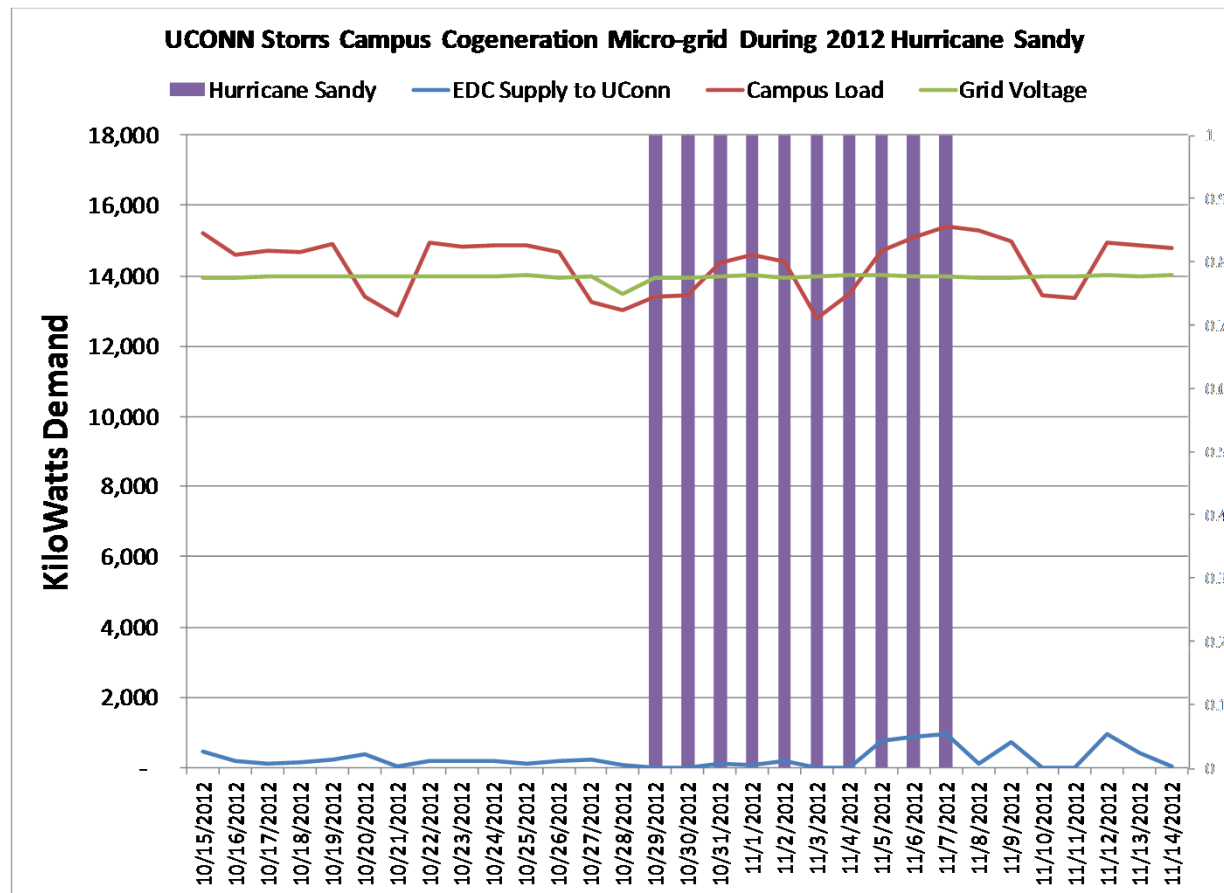
# Storrs Campus Microgrid

- A Co-Generation Plant
  - 3 gas turbines of 7.2 MW each
  - 1 steam turbine 5 MW
  - 3 emergency diesels 4 MW
- Energy efficiency
  - The production of both electrical and steam allows over 80% of the fuel energy to be harnessed, versus 33% from a conventional power plant
  - Natural gas, a cleaner burning fuel, is used



<http://energyservices.uconn.edu/SitePages/Home.aspx>; User Name: FAS\PI, Password: Uconn2011

# Enhanced electricity resiliency



Reduction of outage time by > 98%

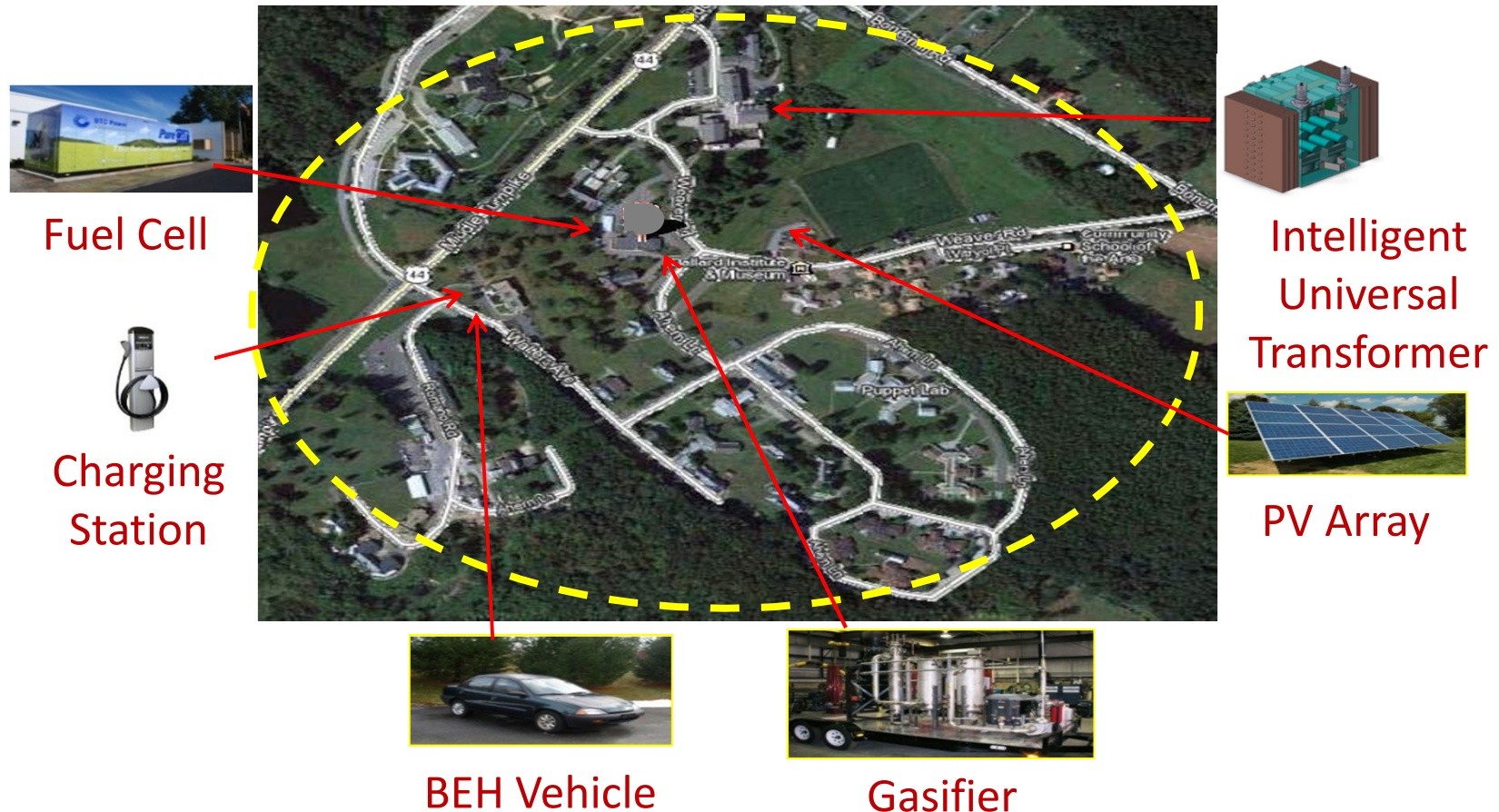
Assuming UCONN CoGen availability: 98%

Utility grid availability: 99.5% (outage time 43.8 hrs)

⇒ UCONN power supply availability: 0.9999% (outage 0.88 hrs)

# UConn Depot Campus Microgrid

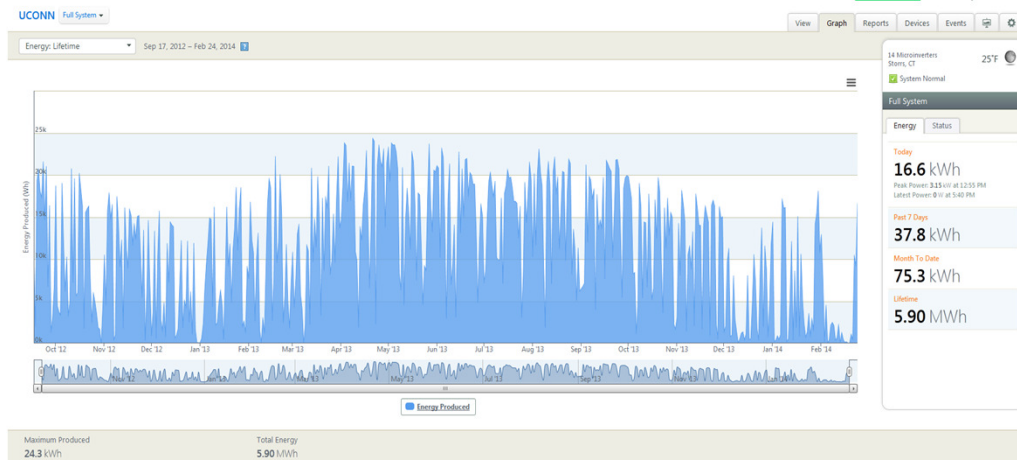
- UCONN received \$2.14M state funding to create a renewable microgrid in collaboration with Schneider Electric, ClearEdge Power, and A/Z Corporation
- Advancing Connecticut's Energy Resiliency – First-in-the-Nation Statewide Microgrid Program



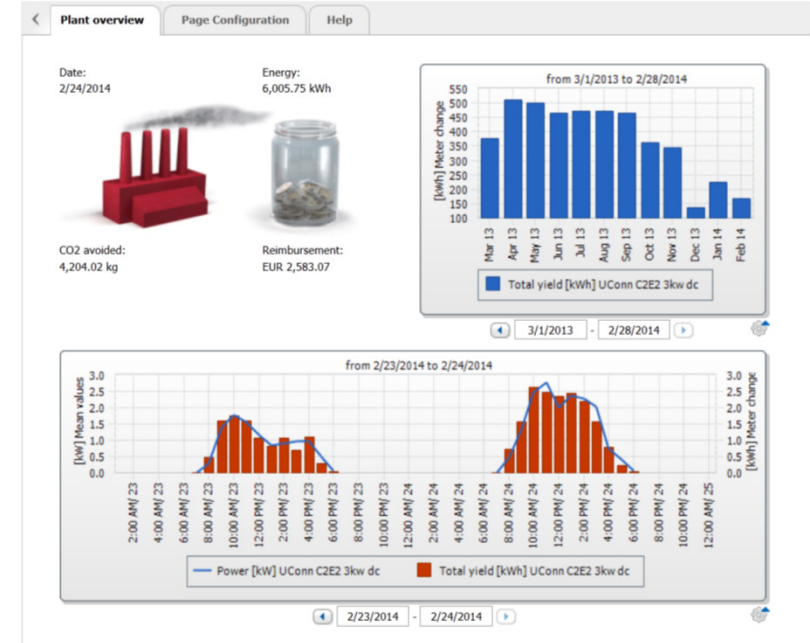
# Energy Efficiency

- The fuel cell has generated 6215 MWh of electricity with a total efficiency of about 55%
- The PV panel has generated 11.8888 MWh of electricity with a total of 18168 lbs carbon offset

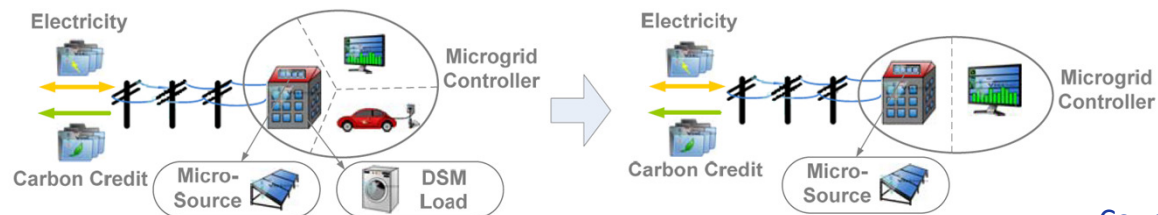
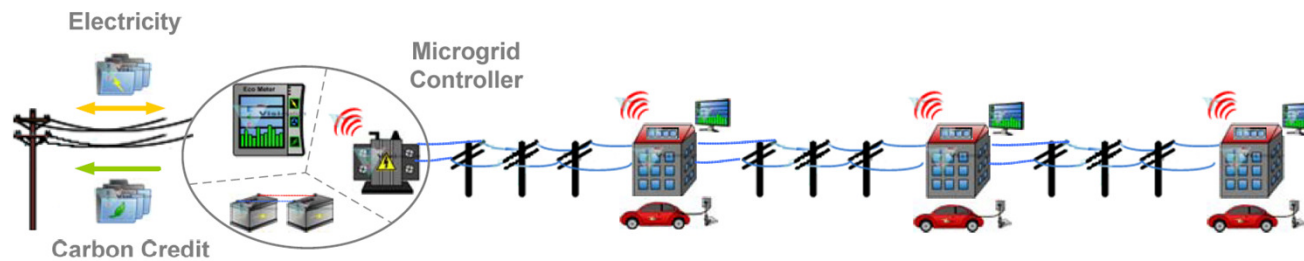
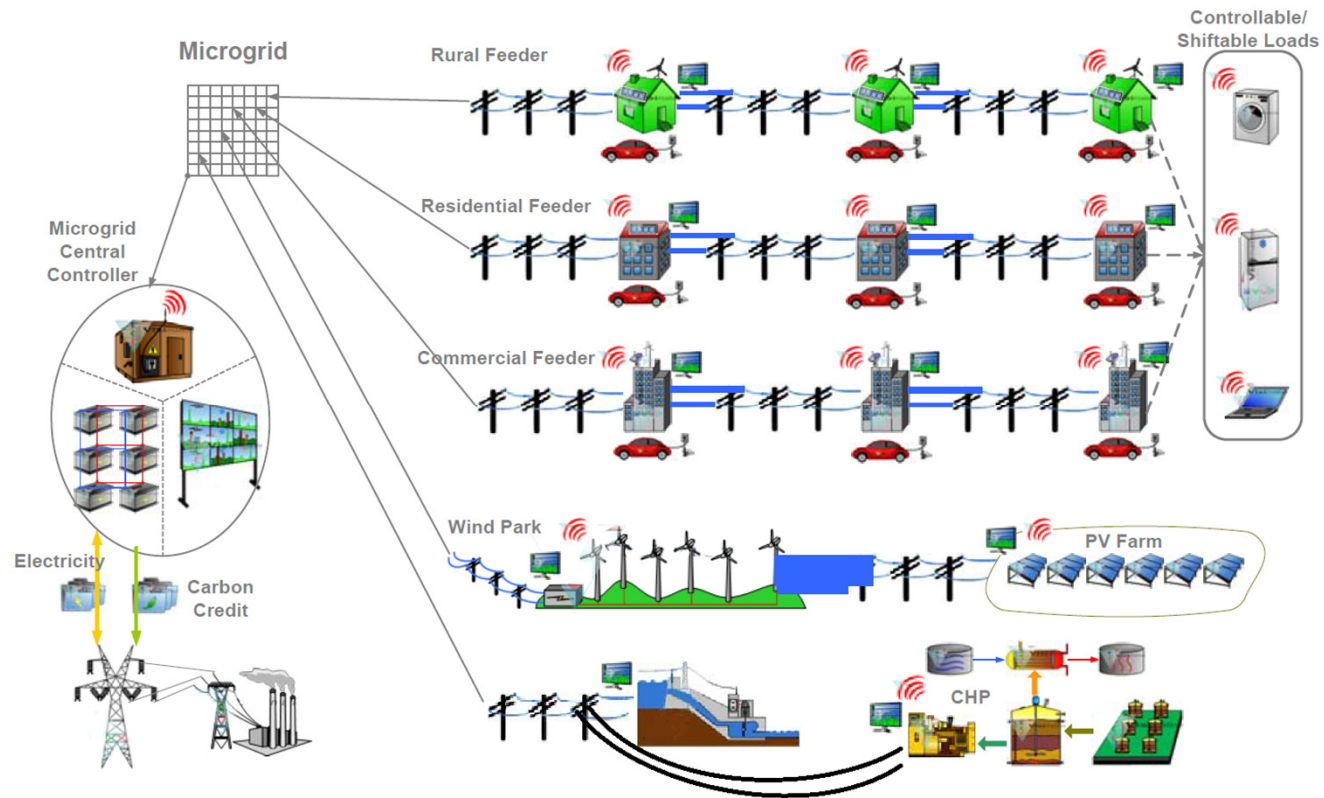
## Microinverter PV



## Centralized PV

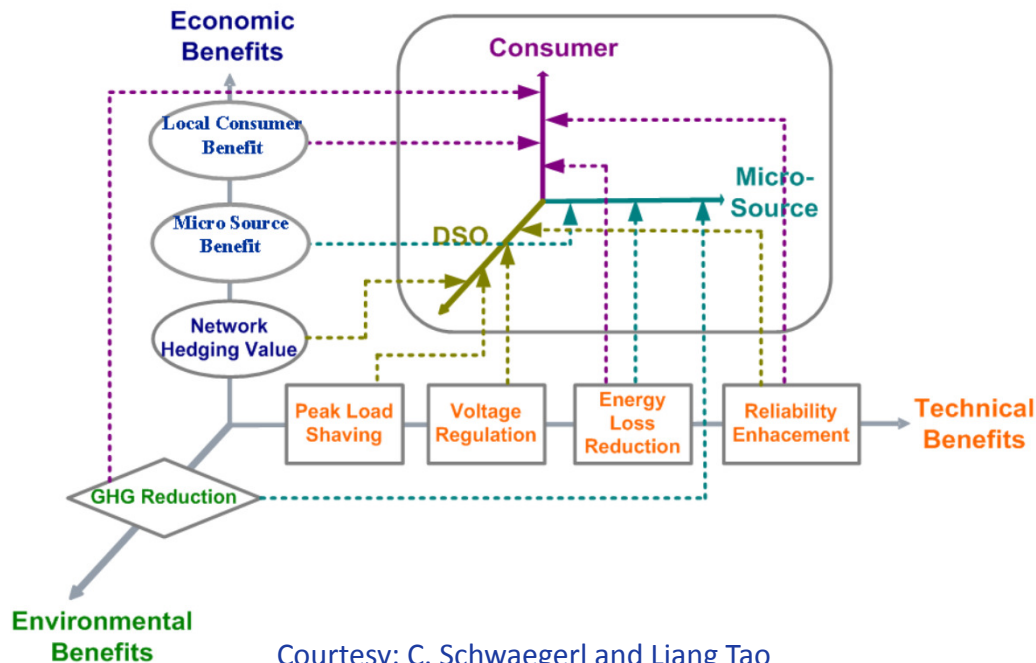






Courtesy: C. Schwaegerl and Liang Tao

# Overview of Microgrid Benefits



## Technical Benefits:

- Infrastructure resilience
- Energy loss reduction
- Improved power quality
- Congestion relief
- Stabilization of distribution and transmission

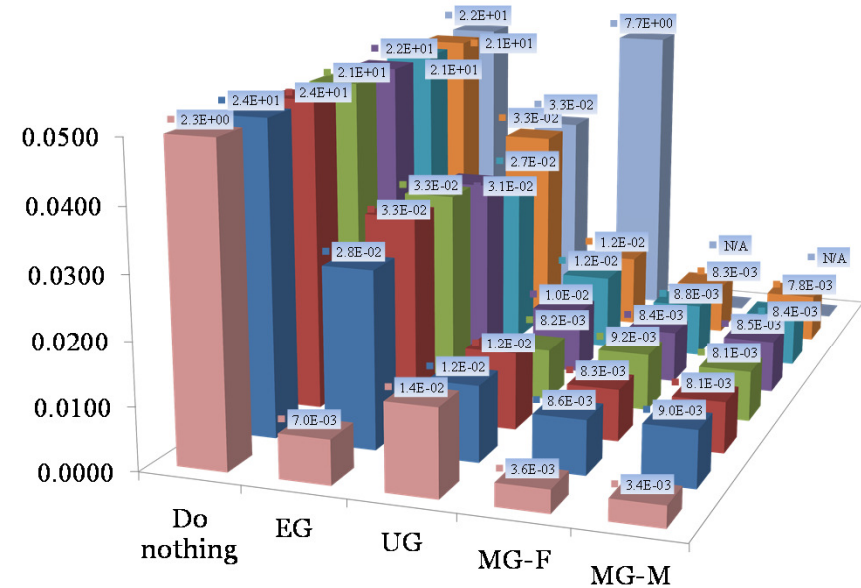
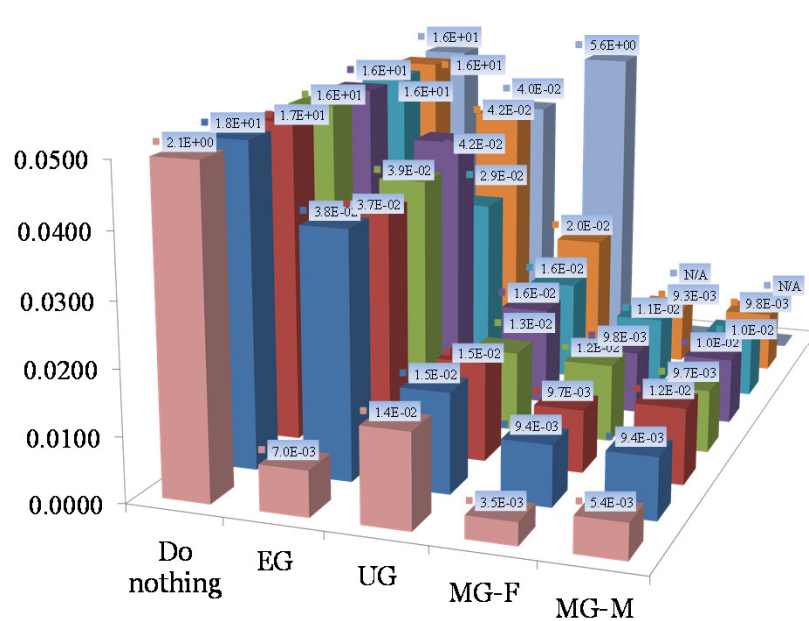
## Economic Benefits:

- Initiator of local retail and service markets
- Hedging against risks- price volatility, outage, load growth...
- Aggregator of supply- and demand side- players
- Interest arbitrator for different stakeholders

## Environmental and Social Benefits:

- Energy saving and carbon footprint reduction
- Job opportunities
- Electrification of remote area, transportation...

# Reliability benefit of microgrid options for selective locations (i.e., town centers or clusters of critical facilities)

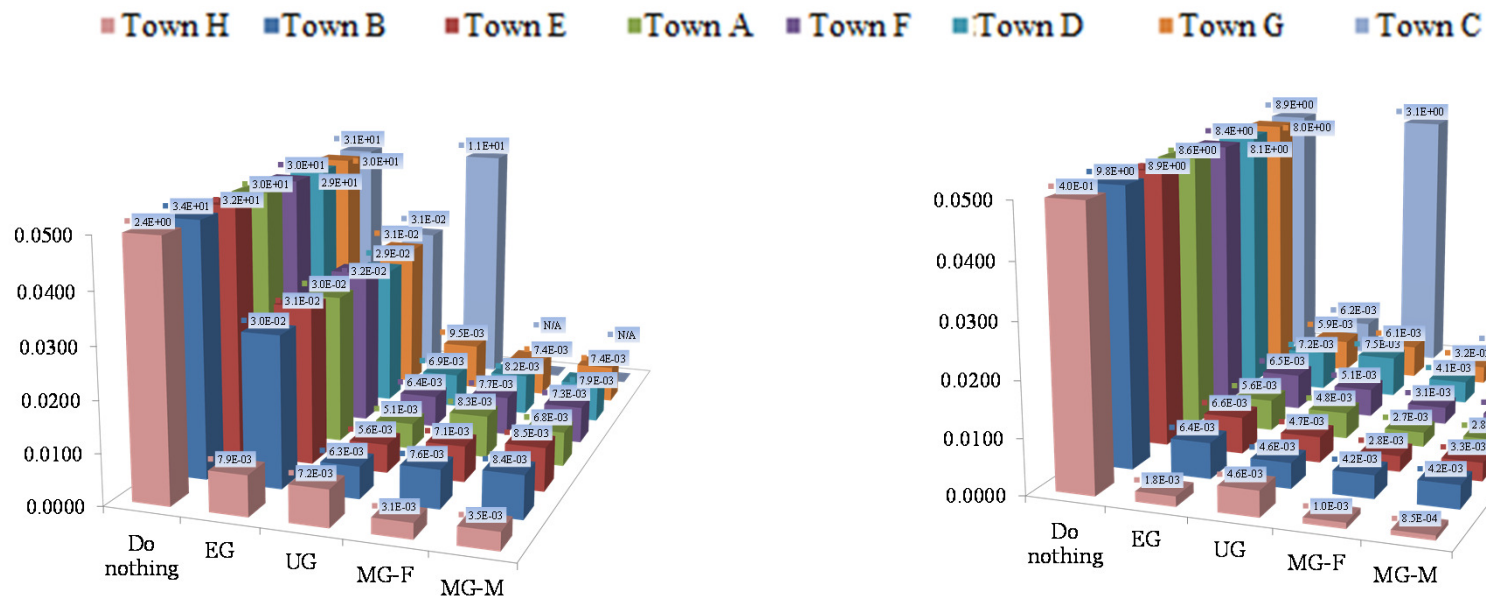


■ Town H 
 ■ Town B 
 ■ Town E 
 ■ Town A 
 ■ Town F 
 ■ Town D 
 ■ Town G 
 ■ Town C

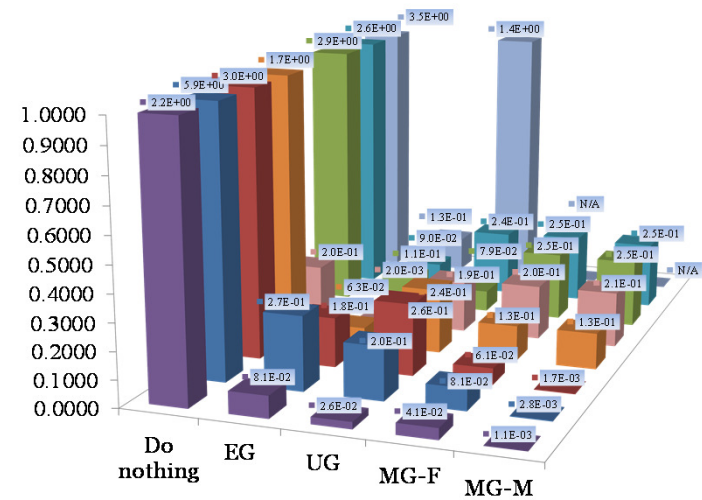
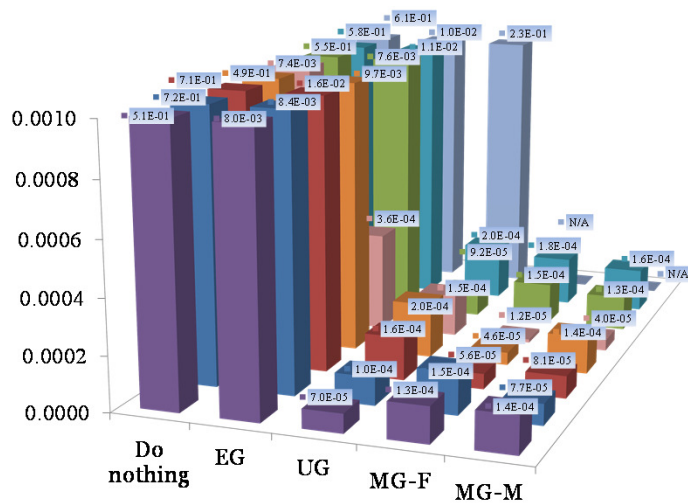
Expected annual outage time under CAT3 storm (hours/year)

Expected annual outage time under CAT2 storm (hours/year)



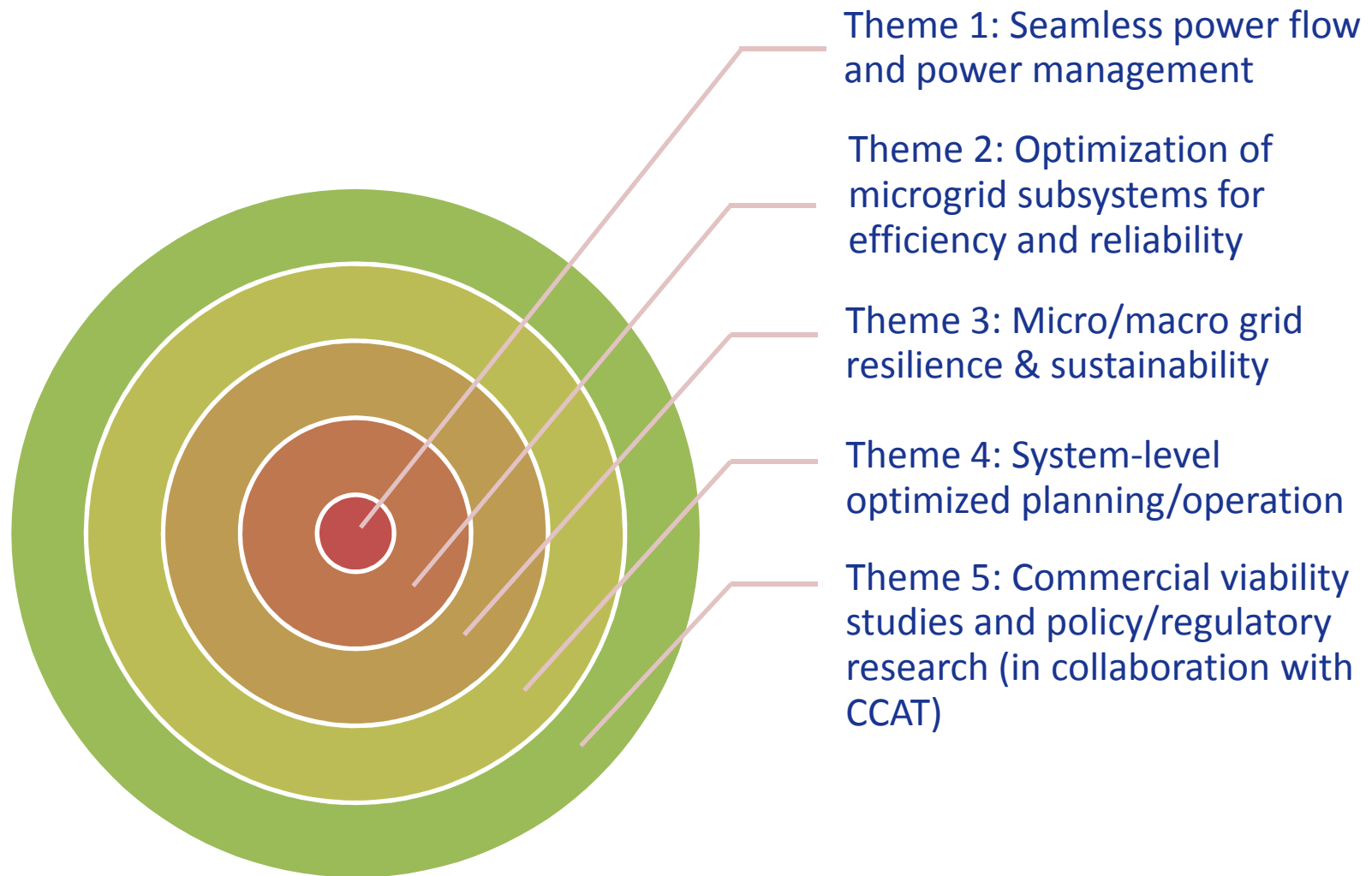


**Expected annual outage time under CAT1 storm      Expected annual outage time under Tropical storm**



**Expected annual outage time under major storm      Expected annual outage time under normal**

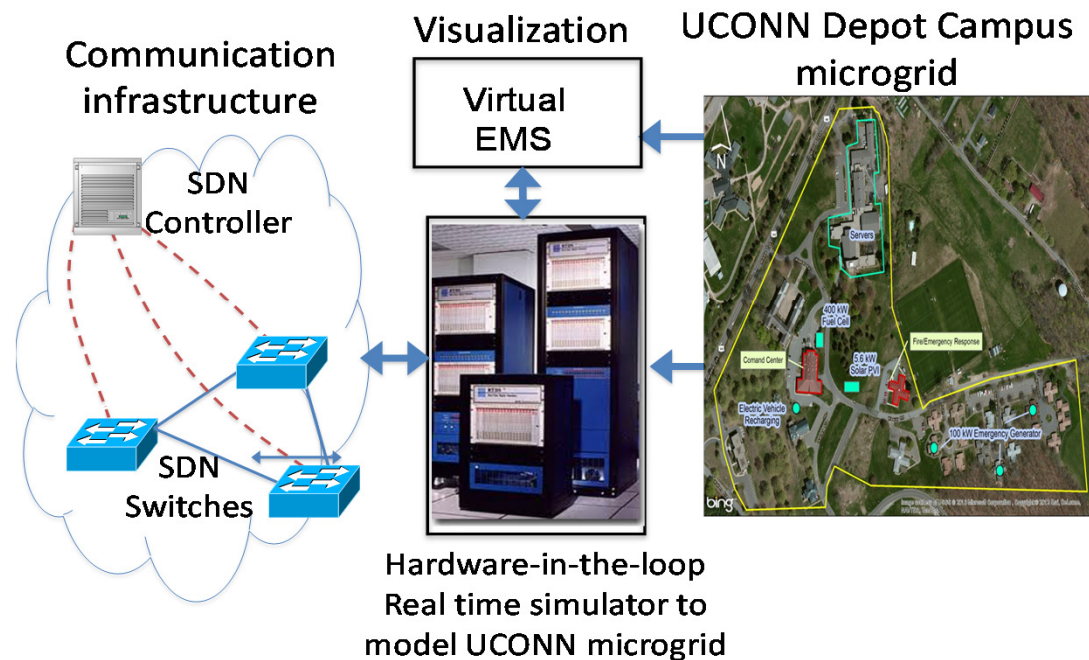
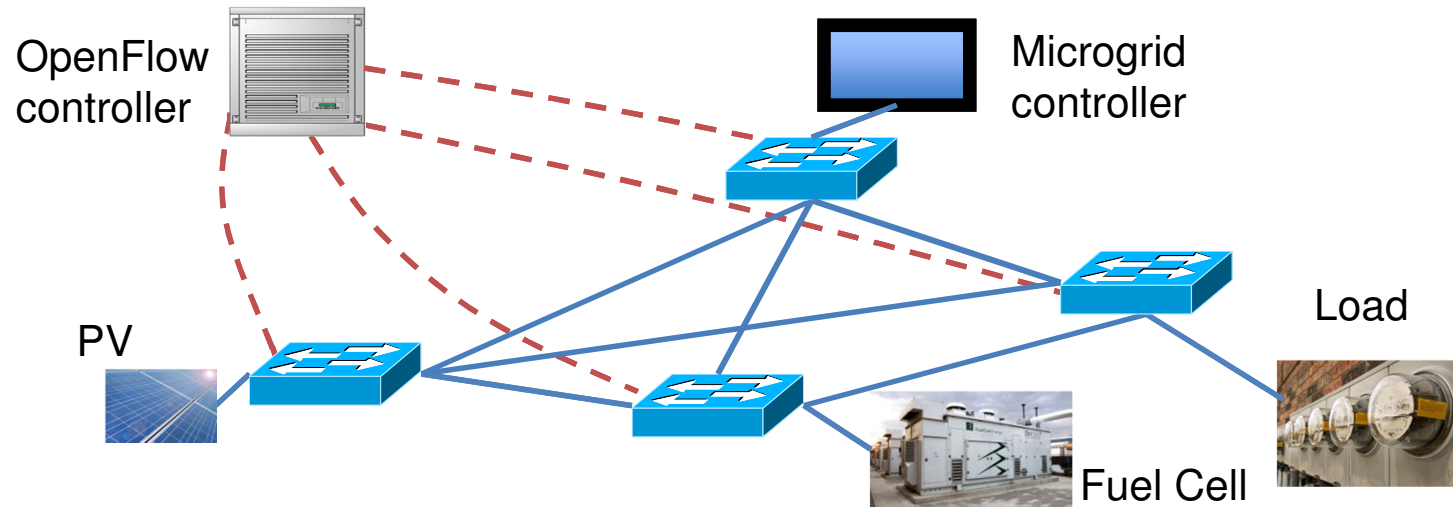
# Capabilities Covering Key Aspects of Microgrids



# Sample research thrusts

- Ultra-fast Programmable Communication Networks
- Optimal Power Flow in Microgrid
- Robust Integration of Intermittent Renewables
- Distributed Optimization of Microgrids Considering Demand Response
- Load/Generation Shedding for Microgrid Resilience
- Reliability Characterization of Microgrids
- Resilient DC Cabling Network

# Enabling highly resilient and efficient microgrids through ultra-fast programmable networks



Thank you!